

## A Research Note

## MACARONI ENRICHMENT WITH DAIRY-BASED PROTEIN SOURCES

E. F. SCHOPPET, H. I. SINNAMON, F. B. TALLEY, C. C. PANZER and N. C. ACETO

## ABSTRACT

Combinations of soluble and heat-coagulated cheese whey proteins, of yeast grown on cheese whey and heat-coagulated whey proteins, and Animal Nutrition Research Council (ANRC) casein alone were used to raise the protein content of conventional macaroni to 20%. All protein sources and combinations tested increased the Protein Efficiency Ratio value of the macaroni to equal to or greater than that of casein. The yeast added a "bitter" flavor and a "sticky" texture. Varying the proportion of soluble and heat-coagulated cheese whey proteins caused no changes in the flavor or texture of macaroni enriched with the heat-coagulated proteins alone. Enrichment with ANRC casein had no effect on the flavor or texture of conventional macaroni.

## INTRODUCTION

PREVIOUS WORK at this Laboratory showed that insoluble cottage cheese whey proteins could be added to macaroni to improve its protein quality to the point where the enriched pasta met the standards of the Federal School Lunch Program (Schoppet et al., 1976). The enriched macaroni was manufactured without changing the traditional process, and the resulting product closely resembled the familiar unenriched macaroni in both flavor and texture. The present work was undertaken for the purpose of expanding the study to other dairy-based protein sources.

Two experiments were performed. In the first, combinations of a soluble cheese whey protein and an insoluble were used to raise the protein level of the macaroni from 13% to about 20%. In the second, a yeast grown on cheese whey and an insoluble cheese whey protein were combined for the same purpose. A macaroni enriched with Animal Nutrition Research Council (ANRC) casein was included in the second experiment.

## MATERIALS &amp; METHODS

THE BASIC INGREDIENT of all products was durum granular flour. The various protein sources are listed in Table 1. The four batches of experimental heat-coagulated cheese whey protein fractions were prepared at this Laboratory as described by Panzer et al. (1976). Variations in the protein content of these four batches were due to variations in the method of separating the insolubilized protein from the whey slurry after heat-coagulation.

Each of the dairy-based protein fractions or combinations of fractions was blended with durum granular flour in proportion to its protein content to yield a 20% protein macaroni on an as-is basis. The macaroni was prepared as previously described by Schoppet et al. (1976). As before, this procedure was the conventional macaroni making process.

The products were tested for Protein Efficiency Ratio (PER) and digestibility by the conventional rat-feeding tests except that five rats were used for each sample instead of ten (AOAC, 1970). The cooked products were tested separately as-is for flavor and texture by a panel of 15-17 trained tasters using a scale of 1 to 4. Differences were determined by use of Duncan's Multiple Range Test (Duncan, 1955).

## RESULTS &amp; DISCUSSION

## Protein quality

The results from the rat-feeding experiments (Table 2) show that all of the dairy-based protein fractions and/or combinations that were tested met the standard for the School Lunch Program (requiring a Protein Efficiency Ratio value for the enriched macaroni of at least 95% that of casein). From the standpoint of protein nutrition, each of these products is an excellent protein source for the enrichment of macaroni.

## Organoleptic

Experiment 1. Previous work reported from this Laboratory showed that a soluble whey protein fraction could not be used alone to prepare enriched macaroni without changing the conventional process (Schoppet et al., 1976). Therefore, we determined how much of the soluble protein could be used. We could use a protein source for enrichment with up to 40% of the proteins derived from the soluble product and 60% from the insoluble. Also, because the taste panel had frequently found the texture of the macaroni enriched with heat-coagulated whey proteins to be somewhat "gritty," although not objectionably so, we attempted to improve the texture by the use of soluble whey proteins. The taste panel results (not shown) indicated that there were no significant differences in texture or flavor among any of the samples of this experiment (listed in Table 2). Thus, the soluble protein can be used for part of the enrichment without affecting protein quality, but its use does not improve the texture of the enriched product.

Experiment 2. We attempted to determine whether a commercially available yeast could be used, alone or in combination with heat-coagulated whey protein, to enrich macaroni without changing the process and the nutritional and organoleptic qualities of the resulting products. A macaroni product enriched with Animal Nutrition Research Council (ANRC) casein was included in this experiment because of current interest in its use as a protein source.

The samples (listed in Table 2) could be manufactured without changing the process, although 25-40% additional water had to be added to the macaroni process when the yeast was used.

The taste panel used plain, unenriched macaroni as the control sample in evaluating the experimental samples. It found ( $p = 0.01$ ) that all samples containing yeast were inferior to the control in flavor and texture. The yeast imparted a "bitter" note and caused a "sticky" mouth feel. The casein, on the other hand, was not significantly different ( $p = 0.01$ ) from the control in flavor or texture.

The criteria used to guide this and the previously reported work were: (1) to prepare protein-enriched macaroni that meets the standards for the Food and Nutrition Service's School Lunch Program (protein content of 20% and PER value at least 95% that for casein); (2) the process used to prepare the desired macaroni would not differ significantly from the typical process; and (3) the desired product would closely resemble common macaroni organoleptically. This and the previous work have shown that several dairy-based protein sources, some of them available

Table 1—Dairy-based protein fractions used for enrichment of macaroni

Protein fraction	Approx protein content <sup>a</sup> (%)
Heat-coagulated cheese whey (4 batches, experimental)	85 72 80 82
Soluble cheese whey (2 batches) <sup>b</sup>	52 54
Yeast grown on cheese whey <sup>c</sup>	57
Heat-coagulated cheese whey <sup>d</sup>	84
ANRC casein	90

<sup>a</sup> As-is basis, the remaining major components being lactose, salts and 3–5% moisture

<sup>b</sup> Stauffer Chemical Co., Westport, CT 06880

<sup>c</sup> CRS Company, St. Paul, MN 55119

<sup>d</sup> Tetroid Co., Inc., Hamilton, NY 13346

commercially, can be used as a protein source to meet the PER criterion. The soluble whey protein, however, can only be used in amounts up to about 40% of the needed added protein because the typical macaroni process becomes inoperative if more is used. Organoleptically, the yeast did not satisfactorily meet the criterion. The heat-coagulated whey protein, alone and in combination with the soluble whey protein, frequently imparted a "gritty" note to the texture of the enriched macaroni which, however, was not strong enough to be considered objectionable. The ANRC casein met all of the criteria. Thus, we believe that protein sources are available today that make it possible for the macaroni manufacturer to prepare an enriched macaroni that meets the standards of the School Lunch Program. Furthermore, he can prepare this product using the typical macaroni process, and the children for whom it is intended will probably accept it if they like common macaroni.

## REFERENCES

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Duncan, D.B. 1955. Multiple range and multiple F tests. *Biometrics* 11: 1.  
Panzer, C.C., Schoppet, E.F., Sinnamon, H.I. and Aceto, N.C. 1976. Continuous coagulation of cottage cheese whey proteins. *J. Food Sci.* 41: 1293.

Table 2—Protein efficiency ratios of dairy-based protein fractions and macaroni products

Dietary source of protein	Approx protein content %	PER adjusted <sup>a</sup>	
		Test #1	Test #2
Experiment 1			
ANRC casein	—	2.50	2.50
Enriched macaroni (20% soluble, 80% insoluble expt'l)	19	2.57 <sup>c</sup>	
Enriched macaroni (20% soluble, 80% insoluble expt'l)	19	2.68	
Enriched macaroni (40% soluble, 60% insoluble expt'l)	19	2.71	
Enriched macaroni (40% soluble, 60% insoluble expt'l)	19	2.95	
Enriched macaroni (100% insoluble expt'l)	19	2.66	
Experiment 2			
Yeast grown on cheese whey (commercial)	57		2.47 <sup>c</sup>
Enriched macaroni (100% yeast) <sup>b</sup>	20		2.54 <sup>c</sup>
Enriched macaroni (50% yeast, 50% insoluble comm.)	24		2.47 <sup>c</sup>
Enriched macaroni (50% yeast, 50% insoluble expt'l)	20		2.79
Enriched macaroni (25% yeast, 75% insoluble expt'l)	20		2.66 <sup>c</sup>
Enriched macaroni (100% ANRC casein)	19		2.59 <sup>c</sup>

<sup>a</sup> Using five weanling rats but otherwise the AOAC method

<sup>b</sup> Data on four rats

<sup>c</sup> Not significantly different from casein ( $p = 0.05$ ) applying Duncan's Multiple Range Test

Schoppet, E.F., Sinnamon, H.I., Talley, F.B., Panzer, C.C. and Aceto, N.C. 1976. Enrichment of pasta with cottage cheese whey proteins. *J. Food Sci.* 41: 1297.

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